McCartney_K_et_al_EESD2020_ZEBhistoric.doc

Combining Sustainable Design Education with Research on Pathway to Zero Energy Historic Buildings

K.McCartney & K. Busby

Centre for Architectural Education, University College Cork & Munster Technological University
k.mccartney@ucc.ie

Abstract

This paper describes an attempt to bring together the Teaching & Learning experience of students of architecture, a live research project, and the collaboration between leaders of separate modules in order to provide a more integrated educational experience. Cork Centre for Architectural Education (CCAE) provides professional degrees which are recognised under the terms of the EU Directive on Professional Qualifications (Architecture). One of its distinguishing features is the inclusion of a Building Conservation module in the third year of its five-year programme. This module is delivered mostly by architects, engineers and historians who also provide professional services in this specialised area. The Third Year Design Studio usually responds to this specialist resource by setting students a design project which involves design for re-use, adaptation, or extension to an existing, and often historic, building.

In 2019, CCAE became the Lead Partner in a Northern Periphery & Artic Region Programme project entitled "Energy Pathfinder – Towards Zero Energy Standards in Historic Buildings", supported by the European Regional Development Fund. Partners in five countries are studying techniques to reduce energy demands and supply renewable energy to meet the balance of energy requirements in Historic Buildings, and to disseminate guidance.

The new, stricter Zero-Energy-Building regulations that have been introduced throughout Europe present considerable challenges and opportunities to product manufacturers, builders, engineers and architects. However, the difficulties are multiplied when dealing with historical buildings, which are often granted exceptions from the strictest energy regulations. The design for retrofitting insulation, for example requires an understanding of the priorities for conservation in different buildings, as well as the skills required to prevent retrofitted insulation and draft stripping from causing problems of condensation and subsequent visual discoloration of finishes, and fabric deterioration. This requires a degree of sophistication in hygrothermal modelling, not always required in new-build design projects. Furthermore, the deployment of renewable energy systems such as photovoltaics, aerogenerators and heat pumps usually demands the installation of large equipment that might detract from the historical environments that society wishes to maintain. The visual impact of these technologies on historic buildings often leads to their rejection.

The research programme requires the creation of demonstration projects in different countries. The building selected as a demonstrator in Cork, the re-use of a large, building used most recently by a religious order. This site was also selected as a conservation-related project for Year Three students.

This paper examines the range of student proposed solutions, and the potential benefits of meshing a live research project into a teaching curriculum, which itself merged five distinct taught modules.

Introduction

Analysis plays an important role in achieving a design output that meets specific needs, However the product of Design is more essentially synthetic as distinct from analytic. Design seeks to bring together solutions to many, often poorly defined, needs. The elegance and efficiency with which a single design can respond to these requirements is what marks successful design products. For this reason, many involved in the teaching and learning of design skills, are challenged by the dominant model of Higher Education which requires learning to be broken onto distinct modules with enumerated Learning Outcomes, each of which might involve developing specific skills. These models are often based on the assumption that fitting the parts together at the end is the easy part, and this synthesis is sometimes left to the student.

This paper describes an exercise in which externally funded research, is closely linked with the Teaching and Learning in Year-3 of a five-year programme leading to the award of a Master of Architecture. Furthermore, it demonstrates some results from linking of five, separate taught modules in Architectural Design Studio, Applied Technology, Conservation and Environmental Design, spanning across two semesters. A shared aim for each module, is to increase a student's ability to contribute to a sustainable built environment. Conservation and creating new functions for old buildings, contributes to social value, and greatly reduces the embodied energy invested in our built environment. Environmental Design aims to create healthy, comfortable, fit-for-purpose buildings. Applied Technology increases awareness of material properties and the design value of specifying and combining appropriate materials and components. The Design Studio classes aim to combine all these functions and others, into a harmonious whole.

Research Programme

The research programme and the educational programme were separately approved and funded. This paper highlights specific advantages to both the research and the educational outcomes, achieved at the cost of additional time devoted to organization and collaboration. The research is part of 'Energy Pathfinder: Towards Zero-Energy in Historic Buildings," a three-year project funded by the Northern Periphery and Artic Programme of the European Regional Development Fund. The research programme, led by UCC, involves partners in the Faroe Islands, Finland, Ireland, Scotland and Sweden. It included demonstration sites where the energy upgrades can be applied. The principal focus for UCC is Myross Wood House, a country estate with a large building built early in 1820 as a private house, but later purchased by a religious order for training purposes. This house is not of outstanding architectural merit, but it is included in the National Inventory of Architectural Heritage (of Ireland). And it has played significant role for the local community as a centre for religious activity. The research programme explicitly addresses the importance of social value as well as architectural value in considering the conservation requirements of historic buildings.

Educational Programme

As a result of the research programme, there two significant reports on Myross Wood House were available before students became involved. Carrig Architects (2020) described the property and its history, and Akiboye Conolly Architects addressed the thermal properties of its construction, its energy demands and potential renewable energy sources. These reports were not delivered to students at the outset but were available to teaching staff. It was intended that students undertake their own investigations and develop strategies in response to their own assessment of the relative value of the different parts of the building. More detailed knowledge was introduced as the student project progressed.

In this way it was intended to simulate the experience of the professional consultants who had produced the two reports.

Figure1: View from East of Myross Wood House in County Cork, a demonstrator in the Energy Pathfinder: Towards Zero Energy for Historic Buildings research programme. To the right, is the original entrance wing facing North-East, to the left is the 1950's reconstructed wing facing South East.

Students were introduced to the project in the Architectural Design Module (AT3001) in Semester One. Three linked projects were set as assignments spanning a total of 10 weeks study:

i) case study of a successful building conservation project coupled with new development to bring new use to a long-established educational site owned by a religious order. [1 week duration]
ii) design study – making an in intervention in the Myross Wood House fabric, with a view to linking the existing building to new development to provide a countryside annex to a city-based School of Architecture. [3 weeks duration]
iii) major design project to produce plans for a new School of Architecture Annex on the grounds of Myross House, linked to the existing building. [6 weeks duration]

In Semester Two, a fourth project was set:

iv) revisit & design in more detail, the intervention in the existing building. [3 weeks duration]

The first stage (i) was supported by a second module in Building Conservation (AT3002) in which the Architects for the conservation case study project (JCA Architects) provided on-site tours and lectures explaining the methods they adopted in selective demolition and restoration to bring new life to a mostly redundant complex of buildings constructed over a period of four centuries.
The second stage (ii) was intended to concentrate the attention of students on an evaluation of the existing buildings, which parts should be preserved, revealed, modified or replaced, and to consider the value of the existing building in relation to the new development of the site, for which they would soon be developing proposals.

The third stage (iii) was intended to challenge students to develop their design skill in generating proposals for a building(s) with complex challenges some of which were:

- location on site (relative to access, services, the existing building, site contours)
- orientation (with regard to views, slopes, solar access and access to north light for for drawing studios
- circulation and universal access
- responding to a specific user group

In the following semester, (project (iv), an additional 3 weeks was devoted to developing the aspect of intervention in the existing building. Students, having now completed the design of the new development, were asked to consider in more detail their intervention in the existing building, taking account of construction details and the environmental design considerations that arise when connecting old and new building materials, and retrofitting insulation to traditional building fabric and integrating renewable energy systems. This involved cooperation between lecturers and tutors in three modules: Architectural Design (AT3005), Applied Technology (AT3007) and Environmental Design (AT3006).

At the time of writing this paper, students were still engaged in their second semester work. Therefore, the paper will describe student outputs from Semester One, and some preliminary outputs from Semester Two.

New Development Proposals

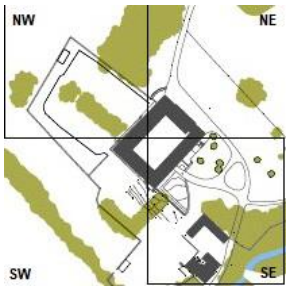

Figure 2 Main entrance to SE

Figure 3: Majority of student development proposals located to NW to SW

Figure 4: Access links through NW & SW wings

Figure 5: New construction within the SE wing maintains courtyard integrity

Thirty-six students participated in this study. Each produced individual proposals. There were however some patterns observed in their approach to siting new development. 78% of students located their new development to the north-west, west, or south west of the existing building.

All students used the existing building as a link to enter their new school design scheme (project-c), but most only used it as an entrance rather than putting significant accommodation into existing spaces. Only a small handful used the formal entrance hall within the 18thC, where the existing access road approaches the property (Figure 2) as the entrance to their scheme, mainly due to access problems, given a complexity of existing level changes. The majority related the entry to new or existing entrance to the courtyard of Myross Wood House.

Most students located their new developments to the Morth-West, West and South-West of the existing building (Figure 3). No students selected the NE quadrant as there was an appreciation that the 18th century landscaping to the front of the original Myross Wood House was too sensitive for redevelopment. New development there would have a detrimental effect on both the aspect and prospect of the front façade.

Several students selected the existing NW and SW wings as a location for their link to the proposed new development, providing access across the existing courtyard and through to the sloping gardens to the NW and SW (Figure 4). In these locations an existing, substantial garden wall was a popular reference feature for locating new-build elements. It offers opportunities for several bioclimatic design advantages which could reduce heating demands:

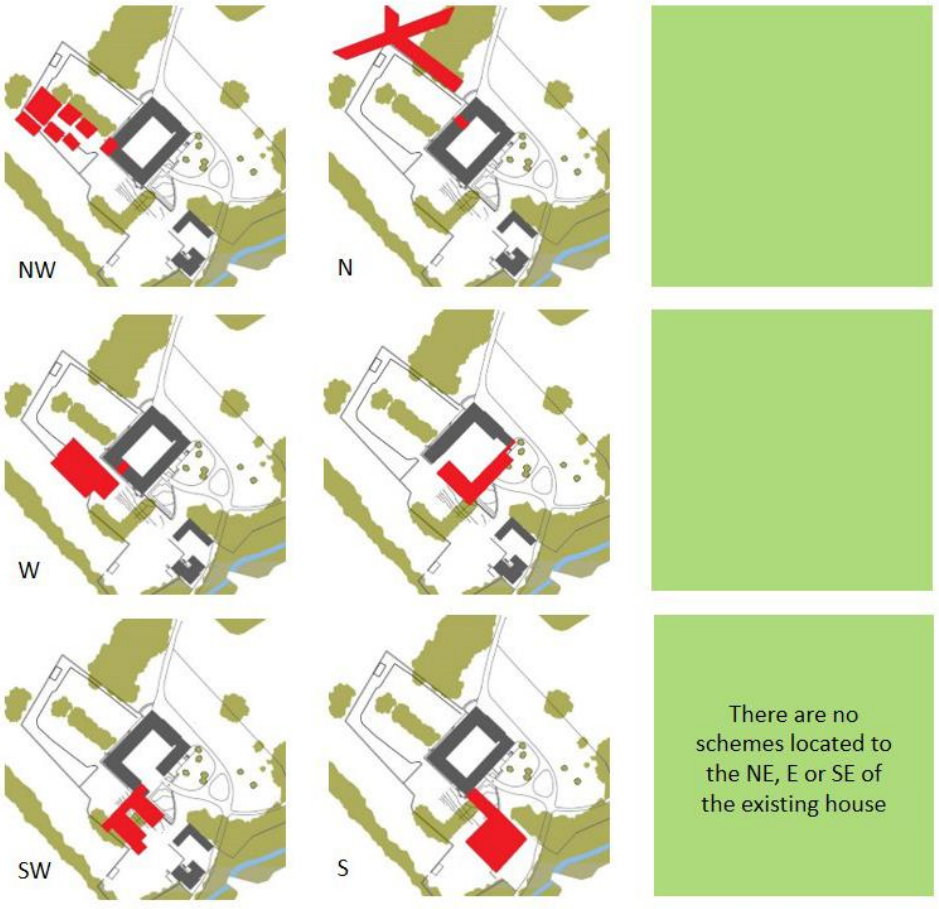

Figure 6: Matrix showing proposed new development locations relative to the house

Design Interventions (modifications to the existing building)

- gently rising slope facing SE with potential morning access to solar gain
- protection from predominant westerly winds (& controlled views to walled garden)
- potential for passive solar heat gain through S, and SE facing glazing

A small number of students chose to demolish the 1959 wing, either as a means of opening up the courtyard or to provide the location for their new accommodation and thereby maintain the integrity of the original courtyard space (Figure 5). The variety of site layout options explored is represented in Figure 6, which illustrates examples of the development proposals on all sides of the Myross Wood House, except the North-East.

In the third project (c) students presented their solutions to expanding accommodation with new construction adjacent to and linked to the existing building. Current opinion on such intervention in historic buildings is that new construction should not imitate the old construction, but rather juxtapose new materials and techniques to clearly demonstrate what elements and materials are new, and which are historic. Where old and new meet, the junction should be clearly expressed, rather than seamlessly merged. One of the most influential proponents of this approach was the architect Carlo Scarpa. "Scarpa was primarily interested in … historical clarity, making history visible by the coexistence of overlaying fragments of construction." (Murphy, 2018, p14)

Several proposals utilised the courtyard as a hub of circulation, both to link wings of the existing building, and to access the proposed new construction. In several examples this was achieved by (a) adding covered external walkways (Figure 7). Other students enhanced long internal corridors by introducing natural light

Figure 7: *In the final stage, students developed a more detailed proposal for the intervention with the existing building including proposals for materials and environmental control. (Caimin Muldoon, 2021)*

and sunshine, through the introduction of roof ridge glazing to the existing building (Figure 8), and by introducing views on to sunlit areas at the ends of pedestrian routes through the building (Figure 9).

Figure 8: Enhancing circulation corridors by introducing building natural light through ridge glazing on the roof (Matthew Hurley, 2021)

Figure 9: Enhancing routes through the by creating sunlit prospects. (M.Hurley 2021)

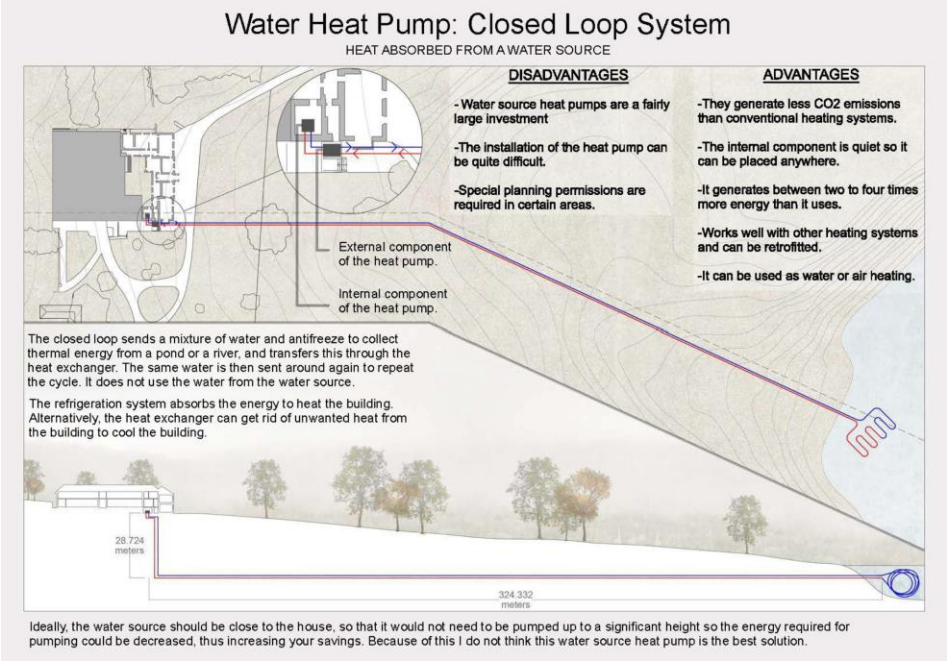

Figure 9: Landscape intervention required for a water-source heat pump in lake Myross Wood House (Klaudia Stasiak; D. Roche; A. Yuhhi; S. Williamson, 2021)

In project (d), the Environmental Design module required students to produce group reports on enhancing the thermal performance of individual elements of the existing building, and later to work individually to propose a coherent design for upgrading the whole building and selecting an appropriate system of renewable energy. The requirements for a water-source heat pump are examined in Figure10.

Conclusions

Although a formal evaluation has not yet been carried out, anecdotal evidence points towards a conclusion that the collaboration between research and teaching, and the collaboration between five different modules created benefits for all stakeholders.

By linking together five different modules it is hoped that it will become clear to students that many different perspectives and skills need to be brought together in order to achieve successful solutions to the complex requirements imposed by the demand for sustainable buildings. Students might also have benefitted from the objective knowledge established in the research project reports, and from interacting directly with experienced professionals who had studied the same issues before them. Dealing with the interconnections between many issues that were formerly raised in separate modules with disparate and unconnected case studies may also have added to the perception of an integrated programme and a sense of the 'connected curriculum'.

Researchers reported that their understanding of Myross Wood House was enhanced by repeatedly describing it to groups of students and attempting to answer their questions. Seeing the range of design proposals produced by 36 students also gave a unique opportunity of examining alternative solutions developed in more detail than would typically be possible by a research team working alone.

Teachers observed the benefits of connecting distinct modules by sharing the same site for project work. This did come at the cost of increased time devoted to coordination of timetables and lecture inputs. However, there were also some savings in preparation time, brought about by in sharing briefing materials such as site drawings and descriptions.

References

Carrig Architects, 2020. *Conservation Report on Myross Wood House*, for Northside Community Enterprises, Cork City, Energy Pathfinder Project funded by Northern Periphery & Artic Region.

Conolly Akiboye Architects, 2021. *Energy Upgrade Study, Myross Wood House,* Northside Community Enterprises, Cork City, for Energy Pathfinder Project funded by Northern Periphery & Artic Region.

Murphy, Richard, 2018. *Carlo Scarpa and Castelvecchio Revisited*, Breakfast Mission Publishing.

Myross Wood House (reg No. 20914210) National Inventory of Architectural Heritage
Myross Wood House, ARDAGH, CORK - Buildings of Ireland